FARM FACTS

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Fertilizer management for seed production of perennial forages in Saskatchewan

Main points to consider when fertilizing perennial forages for seed production:

- Soil test on a regular basis.
- Fertilize according to soil test recommendations.
- Whenever possible, band the fertilizers (particularly P, K and urea-N) into the soil for most efficient use of the nutrients. Alternatively, higher rates of P and K may be broadcast and incorporated into the soil prior to seedbed preparation.
- N management produces the greatest grass seed yield increases but will not increase yield if P, K, and S are limiting, or out of balance.
- Time of N application is critical because many grass species form reproductive tillers in the fall. Therefore, fall application is recommended for many grass species.
- Inoculation of seed with the correct strain of inoculant is critical for producing a healthy stand for legume forage seed production. Focus on correcting P, K and S deficiencies for optimum seed yield of legumes.

Perennial grasses and legumes grown for seed production are important diversification and rotation crops for many Saskatchewan producers. The total area of perennial forages for seed production is estimated to be 38,000 ha. The majority of the forage seed is produced in northeastern Saskatchewan (about 45% of all Saskatchewan forage seed production is in Crop District 8), where it is an important cash crop for producers. Well-managed forage crops reduce soil erosion, improve soil quality, increase soil organic matter levels and enhance the sustainability of other agricultural cropping systems.

Despite the importance of forage crops, limited information is available on the fertilizer management for seed production of perennial forages. Forage seed crops are frequently produced on infertile soils, that increases the importance of nutrient management on these crops.

For healthy growth, plants need 13 or more essential nutrient elements from the soil (e.g., N, P, K, S, Ca, Mg, Cu, Zn, Fe, Mn, B, Mo, Cl, etc.). The required amounts of these nutrients vary widely from year to year for a given crop and also vary considerably from one forage crop to another. In general, N and P are deficient under most soil and crop conditions, and K and S may also be deficient in certain areas. Deficiencies of other plant nutrients are not very common. Like most annual crops, forages respond well to the application of fertilizers on nutrient deficient soils. The purpose of this publication is to summarize field research information on fertilizer management for improving seed production of perennial grasses and legumes in Saskatchewan.

Effect of Nitrogen Fertilizer on Seed Yield

Grasses

Nitrogen (N) increases grass seed yield by promoting the growth of tillers and by stimulating growth of seed heads. The magnitude of seed yield response to N depends on climatic conditions and forage species.

The form of N can have a major impact on the grass seed yield response if a surface-broadcast application method is used. The

best N source for surface-broadcast application is ammonium nitrate (34-0-0), because it is highly soluble in water and readily moves with soil moisture to roots for rapid uptake.

Although urea (46-0-0) is highly soluble in water, it is vulnerable to N loss through ammonia volatilization when surface applied and thus less N may be available. However, all sources of N fertilizers are equally effective when applied just prior to water application (irrigation or a significant precipitation event) or banded below the soil surface. Because grasses efficiently absorb water from soil, the risk of N leaching or denitrification is minimal.

Brown Soil Zone

Increase in the seed yield of smooth bromegrass (SBG) by application of 45 kg N/ha (from both 34-0-0 and 21-0-0-24) was greater from the September 22 than the May 6 application. The seed yield of smooth bromegrass continued to increase with N rate up to 99 kg N/ha for both fertilizers. Between the fertilizer types, the seed yield at different N rates as well as both application times was generally greater with the 34-0-0 than 21-0-0-24 fertilizer.

Application of N at 23, 42 and 99 kg N/ha in fall and mid-April increased seed yield of crested wheatgrass (CWG). The rate of increase was greater with the fall application than mid April application. Similar rates of N application in early May increased the crested wheatgrass seed yield only slightly. The yield response to N rate was also influenced by variation in the annual precipitation.

When two periods with different annual precipitation were compared, the response of crested wheatgrass seed yield to N application was greater in the period with higher (360 mm or about 14 inches) precipitation than with lower (213 mm or about 8 inches) precipitation. Under higher precipitation, the seed yield increased almost linearly with N rate up to 99 kg N/ha; however, under lower precipitation, response to N application was observed only up to 56 kg N/ha.

In a Russian wildrye (RWR) seed yield field study to compare the effects of timing of N application (55 kg N/ha alone, and in combination with P), July application produced significantly higher seed yield than the September, October or April applications. Spring (April) application produced greater seed yield than both the early (September 15) and late (October 15) fall applications, with lowest yield from the October application. There was no consistent difference in seed yield due to the use of either 34-0-0 or 16-20-0 as the N source (i.e., there was no consistent increase in seed yield due to P application).

The highest seed yield of intermediate wheatgrass (IWG) was obtained with fall N application, followed by the post-harvest and early spring applications in a decreasing order.

In trials at Swift Current, 50 kg N/ha increased dryland Altai wildrye (AWR) seed yield by 23 kg/ha. Application of 25 kg N/ha in combination with P also increased the seed yield by 23 kg/ha. Other studies have measured increased seed yield with N fertilization, but maximum yields were attained with less than 100 kg N/ha. Altai wildrye is generally a low seed yielding species, so numerical increases in seed yield appear small.

Dark Brown Soil Zone

In studies at Saskatoon and Outlook, a fall application of 100 kg/ha of N increased seed yields of meadow bromegrass by 200 to 450 kg/ha in the second production year, providing residue was removed directly after seed harvest in the previous year. In the third production year, seed yields were increased only by 30 to 90 kg/ha with 100 kg/ha of N applied the previous fall.

Black and Gray Soil Zones

At 10 sites in northeastern Saskatchewan, the response of smooth bromegrass, crested wheatgrass, intermediate wheatgrass and timothy to spring-applied N fertilizer was studied from 1988 to 1991. The seed yield of all forage species was significantly increased by N application and generally was

dependent on the soil and climatic conditions.

For example, seed yields of smooth bromegrass ranged from a low of 290 kg/ha in a dry year (1990) to a high of 1240 kg/ha in a moist year (1989). The estimated seed yield response of smooth bromegrass to 50 kg N/ha ranged from 571 kg/ha on a soil low in available N to a negative response of –285 kg/ha on a soil testing high in available N. The high correlation of seed yield to soil test data clearly established the significance of nutrient status of the soil in making more precise fertilizer recommendations. In a N fertilization trial with smooth bromegrass in northeastern Saskatchewan, more than two fold increase in seed yield was measured.

Summary:

SBG	Fall	>	Spring
CWG	Fall	>	Spring
RWR	Favored timing is July		
RWR	Spring	>	Fall

Legumes

Legumes coexist with Rhizobium bacteria that can induce nodulation and convert the N from the air to a form that is available to plants. Consequently, no N fertilizer is required for legumes provided they are inoculated with appropriate Rhizobium bacteria (specific to each plant type) using a proper procedure. Application of N fertilizer may reduce N fixation by the nodulation bacteria. The results of field experiments conducted at 10 sites in Saskatchewan showed that there was no significant increase in seed yield of alfalfa from N fertilization, irrespective of soil type and climatic conditions.

Effect of Phosphate Fertilizer on Seed Yield

Grasses

Application of P to dryland Altai wildrye at Swift Current, in 25-25 and 50-50 kg combinations of N-P_2O_5/ha increased seed yield over application of N alone. There was no consistent difference in the seed yield of Russian wildrye from either 34-0-0 or 16-20-0 fertilizer, when both provided 55 kg N/ha and no response to the P in 16-20-0. Application of P at 23 and 47 kg P_2O_5 /ha in fall produced only a marginal increase in crested wheatgrass seed yield.

Field experiments to study the response of smooth bromegrass, crested wheat grass, intermediate wheat grass and timothy to 0, 9 and 18 kg P/ha fertilization were conducted at 10 sites in northeastern Saskatchewan from 1988 to 1991. The seed yields of all species were significantly increased by P application, except for intermediate wheatgrass. In general, there was an increase in seed yield to P rate, but not in all cases.

Unlike N, which moves relatively freely with water in soil, P is immobile. For this reason, banding of P fertilizer in the soil where it will be directly intercepted by roots is very important. However, research information on appropriate method of P application for forage seed production is lacking. Most data were collected from Black and thin Black soils with high soil test P content. In contrast, seed production is often on the less fertile Gray soils.

Legumes

Field experiments at 10 sites in northeastern Saskatchewan were conducted to study the response of alfalfa seed yield to the application of 0, 9, 18, 27 and 54 kg P/ha from 1988 to 1991. The application of P produced a significant increase in seed yield of alfalfa, although the response varied with site.

For example, the increase of alfalfa seed yield from 20 kg P/ha was 36 kg/ha at Eggerman farm (Black soil) but little or no increase in seed yield at Newfield and Youzwa farms (Dark Gray soils) because of higher soil test P levels and weather effects.

Effect of K Fertilizer on Perennial Forage Seed Yield

Potassium stimulates fixation of N by Rhizobium bacteria and decreases the incidence of winter injury in legume stands by increasing the accumulation of carbohydrates in the root system of legumes. Under K-deficient conditions, the legume plant density was reduced, thus potentially reducing seed production.

Potassium is a nutrient that is used in large quantities by most crops.

The majority of Saskatchewan soils contain adequate amounts of K for perennial forages, but some coarse-textured (loamy sand and sandy loam) and organic soils are likely to be K deficient. On K-deficient soils, perennial forages may benefit from K fertilization. Field research information on the seed yield responses of perennial forage grasses and legumes to K fertilization on various soils is lacking. When applying K fertilizer, banding is the preferred method of application, and K can be banded with a blend of P fertilizer.

Effect of S Fertilizer on Seed Yield

Sulphur is an essential nutrient for N-fixing bacteria in legume crops, and S affects both yield and quality of seed in legumes. Sulphur is likely to be severely deficient in many Gray and Dark Gray soils and some coarse-textured Black soils in northeastern Saskatchewan. Also, S deficiencies can occur anywhere in Saskatchewan as has been experienced with canola production.

On S-deficient soils, increases in forage seed yields (especially for legumes because of their higher requirements for S than grasses) can be expected from relatively small annual additions of sulphate-S, but little information is available for Saskatchewan conditions. Soils should be tested regularly to insure that an adequate supply of S is available in soil.

Both legume and grasses will respond to S fertilizer (sulphate form) where S is deficient. Sulphate-S is a mobile nutrient and soil testing to the two-foot depth is encouraged.

Effect of Micronutrient Fertilizers on Seed Yield

There is a lot of discussion on the role of micronutrients in forage seed production. Most soils in Saskatchewan are adequately supplied with micronutrients and deficiencies of micronutrients are rare.

In the few field studies conducted in Saskatchewan on the effects of micronutrient fertilization on forage seed production, seed yield responses to micronutrient fertilizers were small and inconsistent. Therefore, no general conclusions can be drawn regarding the response of forage seed yield to micronutrient fertilizers. In order to determine which micronutrient is limiting in soil, soil and tissue testing is suggested. In addition, it is important for producers to try on-farm testing in small areas to determine seed yield responses to micronutrient fertilizers before making major changes in overall fertilizer programs.

Metric to Imperial conversion

- kg/ha x 0.89 = lb/a
- ha x 2.47 = acre

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